PREVALENCE OF VISIBLE AND OCCULT BLOOD ON AIRWAY MANAGEMENT EQUIPMENT USED OUTSIDE THE OPERATING ROOM

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Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
OCT 1999	**N/A**	**-**

4. TITLE AND SUBTITLE
PREVALENCE OF VISIBLE AND OCCULT BLOOD ON AIRWAY MANAGEMENT EQUIPMENT USED OUTSIDE THE OPERATING ROOM

5a. CONTRACT NUMBER
5b. GRANT NUMBER
5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
RACHAEL JEANNE NIKKOLA, BSN, LT, NC, USN

5d. PROJECT NUMBER
5e. TASK NUMBER
5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Uniformed Services University of the Health Sciences

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

10. SPONSOR/MONITOR'S ACRONYM(S)
11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release, distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT
Unintentional transmission of blood-borne pathogens to patients, self, and co-workers is an inherent, but preventable hazard to those who provide anesthesia services. Anesthesia providers, their equipment, and monitors located within the operating room have often been shown to be contaminated with visible or occult blood in addition to potential pathogens. The potential to spread certain blood-borne pathogens such as human immunodeficiency virus (HIV), and hepatitis B & C virus s (HBV, HCV) is a major concern. The purpose of this study was to determine how effective current procedures for cleaning, disinfection, and handling of airway management equipment (AME) stored in emergency crash carts, airway management carts, and airway management bags, located outside the operating room, are for removing blood. An additional purpose was to compare these data with previous studies on such equipment used within the operating room. A descriptive survey was conducted on AME located outside the operating room on seven separate units within a large military medical facility. AME was inspected for visible blood and then tested for occult blood utilizing a modified phenolphthalein test. This study found a 3% incidence of visible blood and an overall prevalence of occult blood to be 17%. These findings are consistent with similar studies that looked at the AME used within the operating room. These data identify lack of compliance of established OSHA and EPA standards regarding high-level disinfection. Improperly cleaned AME continues to be used when performing lifesaving procedures, potentially exposing health care providers and their patients to life threatening infectious diseases.

15. SUBJECT TERMS
Airway Management Equipment, Infection Control, Visible Blood; Occult Blood, Contamination; Emergency Crash Carts; Airway Management Carts; Airway Management Bags; Phenolphthalein Test

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**SAR**	**69**	

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39-18

DISCLAIMER STATEMENT

Department of Defense

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ABSTRACT

Unintentional transmission of blood-borne pathogens to patients, self, and co-workers is an inherent, but preventable hazard to those who provide anesthesia services. Anesthesia providers, their equipment, and monitors located within the operating room have often been shown to be contaminated with visible or occult blood in addition to potential pathogens. The potential to spread certain blood-borne pathogens such as human immunodeficiency virus (HIV), and hepatitis B & C virus s (HBV, HCV) is a major concern. The purpose of this study was to determine how effective current procedures for cleaning, disinfection, and handling of airway management equipment (AME) stored in emergency crash carts, airway management carts, and airway management bags, located outside the operating room, are for removing blood. An additional purpose was to compare these data with previous studies on such equipment used within the operating room. A descriptive survey was conducted on AME located outside the operating room on seven separate units within a large military medical facility. AME was inspected for visible blood and then tested for occult blood utilizing a modified phenolphthalein test. This study found a 3% incidence of visible blood and an overall prevalence of occult blood to be 17%. These findings are consistent with similar studies that looked at the AME used within the operating room. These data identify lack of compliance of established OSHA and EPA standards regarding high-level disinfection. Improperly cleaned AME continues to be used when performing lifesaving procedures, potentially exposing health care providers and their patients to life threatening infectious diseases.

Key Words: Airway Management Equipment, Infection Control, Visible Blood, Occult Blood, Contamination, Emergency Crash Carts, Airway Management Carts, Airway Management Bags, Phenolphthalein Test.

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THESIS

Presented to the Graduate School of Nursing Faculty of

the Uniformed Services University of the Health Sciences

in Partial Fulfillment

of the Requirements

for the Degree of

MASTER OF SCIENCE DEGREE

UNIFORMED SERVICES UNIVERSITY OF THE HEALTH SCIENCES

October 1999

FORWARD

This research was conducted to provide valuable information regarding the prevalence of visible and occult blood on airway management equipment used outside the operating room for anesthesia providers, hospital and unit infection control officers, and ancillary personnel in the military and civilian population who may be involved in emergency airway management. It was designed to support increasing efforts aimed at reducing transmission of blood-borne pathogens to health care providers and their patients.

DEDICATION

In loving memory of Jose Vidal, from whom I received unconditional acceptance, love, and friendship. He allowed me to voice my feelings, fears, and tribulations, providing me the strength and encouragement to face difficult challenges directly and honestly. You will never be forgotten.

ACKNOWLEDGMENT

To my husband Gary, who has been Mr. Mom, Mr. Editor, and most of all, Mr. Cheerleader throughout this thesis process. Thank you for your steadfast love, support, and encouragement, especially during my stressed-out and frazzled times. You have truly been the wind beneath my wings .

And to my daughter Madison, who has shown extreme patience and understanding throughout my graduate education. You endured more cancellations of girls day out at the mall than any young teenager should have to. Thanks for your continual support you gave during this exciting but long journey!

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I: INTRODUCTION

Background of the Problem

Between two and 15 percent of patients admitted to general hospitals develop nosocomial infections. In tertiary care and university hospitals, the occurrence is even greater. Bready (1988) states that as many as 1.5 to 2.5 million people per year contract hospital-acquired infections, and approximately 15,000 patients are thought to die annually from nosocomial infections (p. 89). Such infections are known to primarily result from the phenomenon of cross-contamination where transmission of a pathogen occurs from one patient to another. Tait and Tuttle (1995) report annual costs from such infections to be between five and 10 million dollars. Risk of acquiring a nosocomial infection escalates in critically ill patients and in those requiring invasive surgical, monitoring, and diagnostic techniques (Bready, 1988).

The Centers for Disease Control and Prevention (CDC, 1997) recently reported 86,972 individuals have acquired the human immunodeficiency virus (HIV) between July 1995 through June 1997, with approximately 311,000 deaths from acquired immunodeficiency syndrome (AIDS). According to Kent (1996), 14,591 cases of AIDS occurred among health care workers between 1981-1994. Furthermore, it is estimated that 8,700 hepatitis B virus (HBV) infections occur annually among health care workers in the United States (Tait & Tuttle, 1994). This data clearly shows blood-borne pathogens to be a constant, deadly, infection control problem with potential to affect anesthesia providers, their clients, and co-workers.

In 1993 the American Association of Nurse Anesthetists (AANA) stated in their Infection Control Guide that anesthesia providers are subject to the risk of infection and subsequent illness with each exposure to bloodborne pathogens and infectious or potentially infectious substances or materials. Therefore, every Certified Registered Nurse Anesthetist

(CRNA) and each employer must meet or exceed the standards and rules set forth by the Occupational Safety and Health Administration (OSHA) and the Environmental Protection Agency (EPA) to provide minimal protection to health care workers. Recommendations set forth by CDC are aimed primarily at protecting the public. These principles are so important that non-compliance of the standards can lead to fines or lack of accreditation (AANA, 1993). Crow (1993) reminds health care providers that regardless of the sterilization process selected, an item must be cleaned thoroughly before the process can be effective. If an item cannot be cleaned, it cannot be sterilized or disinfected (p. 687).

Rationale and Statement of the Problem

Unintentional transmission of blood-borne pathogens to patients, self, and co-workers is an inherent, but often a preventable hazard to those who provide anesthesia services. Anesthesia providers, their equipment, and monitors located within the operating room have shown to be contaminated with visible or occult blood, in addition to potential pathogens (Crow, 1991; Hall, 1994; Morell, Ririe, James, Crews, and Huffstetler, 1994, Tessler, Grillas, & Gioseffini, 1994; Phillips & Monaghan, 1997, Perry & Monaghan, 1998). Thus, the potential to spread certain blood-borne pathogens such as HIV, HBV, and hepatitis C virus (HCV) is a major concern.

Anesthesia providers deliver the majority of their services within the controlled environment of the operating room. However, due to their specialty, they respond to routine procedures and emergencies throughout the hospital or medical center; areas in which they have little or no control over the cleaning and disinfection procedures of the airway management equipment (AME) they will ultimately use. Therefore, the effectiveness of cleansing, disinfection, and sterilization of AME in crash carts, airway management carts, and airway management bags utilized

outside the operating room, needs to be verified.

Aim of the Study

The aim of this study was to determine the incidence of visible and occult blood on AME located in crash carts, airway management carts, and airway management bags identified as ready for patient use.

Major Research Questions

This study attempted to answer the following questions:

1. How effective are current procedures for cleaning, disinfection, sterilization, and handling of AME located in emergency crash carts, airway management carts, and airway management bags, located outside the operating room, for removing blood as evidenced by the lack of visible and/or occult blood on laryngoscope blades, handles, and Magill forceps identified as ready for patient use ?
2. Is there a difference in occurrence of visible or occult blood on AME located in crash carts, airway management carts, and airway management bags, compared to equipment used in operating rooms?

Conceptual Model and Theoretical Framework

The roots of modern nursing are based on the work of Florence Nightingale. Nightingale s grand theory places great emphasis on environmental factors that affect the wellness of patients. She believed that healthy surroundings were essential for proper nursing care (de Graff, Marriner-Tomey, Mossman, & Slebodnik, 1994). Nightingale did not accept the current germ theory of her time; however, she developed and implemented the idea of asepsis as a means to control infection. She believed cleanliness extended to the patient, the nurse, and the environment. She also felt that the nurse s role was to prevent the healing process from being interrupted and to enhance this process by

providing optimal environmental conditions.

The identification that thorough cleaning, disinfection, and sterilization of medical instruments and equipment could prevent nosocomial infections revolutionized the delivery of health care. Research performed by German bacteriologist, Robert Koch (1843-1910), identified the disinfecting properties of steam and hot air, introducing the world to the science of disinfection and sterilization (Groah, 1983). By 1885, surgical dressings were sterilized by steam, as Von Esmarch and Max Rubner advanced this technology. In 1859, C.A Wurtz discovered ethylene oxide (ETO), and in 1929, it was found that this agent possessed bactericidal properties. By the late 1950s, ETO was being used in hospitals as a sterilizing agent, followed by various liquid chemicals.

By the late 1960s, Dr. E.H. Spaulding, renown for his work on chemical disinfection and asepsis in hospital settings, developed a classification system which identified appropriate levels of disinfection and sterilization procedures for all medical instruments, equipment, and environmental surfaces in patient care areas (AANA, 1993; Rutala, 1996). The American Practitioners of Infection Control (APIC), CDC, and OSHA embraced his system as the framework for all health care facilities to follow in order to prevent and control nosocomial infections. Dr. Spaulding s classification system was revised by the CDC and APIC in 1991, and the AANA (1993) modified this framework to meet the specific needs of anesthesia practice. The categories are now described as:

Critical Risks

Items that gain entry into a sterile area of the body or the vascular system must be sterile at the time of use. Examples include, but are not limited to, needles (injection, spinal, and epidural needles), implants, catheters, and intravenous tubing.

Semicritical Risks

Items that come in contact with mucous membranes should be sterile or have been treated to achieve a state of high-level disinfection. Examples include laryngoscope blades and handles, fiberscopic laryngoscope systems, Magill forceps, stylets, reusable temperature probes, esophageal catheters, breathing circuits, and masks.

Noncritical Risks

Items that don t make contact with the patient and devices that touch intact skin should be cleaned by employing intermediate or low level of disinfection. Examples include blood pressure cuffs, skin temperature probes, pulse oximeter sensors, electrocardiogram cables and electrodes, and stethoscopes.

Environmental Surfaces

Includes medical equipment surfaces, such as carts, knobs, and handles. Intermediate or low-level disinfectant should be used between cases in order to achieve a safe level of decontamination.

According to AANA standards (1993), devices and ancillary instruments that make direct contact with mucus membranes such as laryngoscopy handles and blades, Magill forceps and stylets, and fiberoptic laryngoscopy systems, should be decontaminated with a detergent and water solution and subjected to a high-level disinfection process or sterilized before reuse (p. 20).

Definitions

The following are key words that were used in this study in regards to environmental conditions:

Conceptual Definition

Florence Nightingale described the components of the environment in concepts of ventilation, warmth, light, diet, noise, and cleanliness, with the latter being a major component in her grand

theory for nursing. Murray and Zenter (1975) defined the environment as capable of preventing, suppressing, or contributing to disease, accidents, or death, and is all the external conditions and influences affecting the life and development of an organism (p. 149). Today, we manipulate the environment of the occupational setting by many different means.

Operational Definitions (OSHA, 1991; Rutala, 1996)

Sterilization.

The complete elimination or destruction of all forms of microbial life. It is accomplished by either physical or chemical processes such as steam under pressure, dry heat, ethylene oxide gas, and liquid chemicals such as peracetic acid.

Disinfection.

A process that eliminates many or all pathogenic microorganisms, with the exception of bacterial spores from inanimate objects.

High-level disinfection.

Can be expected to destroy all microorganisms, with the exception of high numbers of bacterial spores. Includes glutaraldehyde and hydrogen peroxide solutions.

Intermediate-level disinfection.

Inactivates Mycobacterium tuberculosis, vegetative bacteria, most viruses and fungi, but does not necessarily kill bacterial spores. Includes 70% alcohol solutions, phenolics, and iodophors.

Low-level disinfection.

Can kill most bacteria, some viruses and fungi, but cannot be relied upon to kill resistant microorganisms such as tubercle

bacilli or bacterial spores. Examples include the quaternary ammonium compounds such as benzalkonium chloride.

Germicide.

An agent that destroys microorganisms, particularly pathogenic organisms. Agents are designated by words with the suffix —cide (e.g., virucide, fungicide, bactericide, sporicide, and tuberculocide) destroy the microorganisms identified by the prefix.

Chemical Sterilants.

Chemicals that are used for destroying all forms of microbial life, including fungal and bacterial spores. Examples include glutaraldehyde-based formulations, stabilized hydrogen peroxide, and peracetic acid.

Disinfectant.

A germicide that inactivates most recognized pathogenic microorganisms but not necessarily all microbial forms on inanimate objects (e.g., bacterial endospores).

Cleaning.

The removal of all foreign material, including inorganic and organic material, from objects.

Nosocomial infection.

Infections that are acquired while staying in a hospital (Bready, 1988).

Universal precautions.

Recommendation guidelines developed by the CDC with the intention to prevent parenteral, mucous membrane, and non-intact skin exposure of health-care workers to infectious pathogens such as HIV, HBV, and HCV by blood and certain body fluids from patients. These precautions apply to all human

tissues, cerebrospinal fluid (CSF), pleural fluid, peritoneal fluid, pericardial fluid, amniotic fluid, synovial fluid, semen, vaginal secretions, saliva in dental procedures, human breast milk, any body fluid that is visibly contaminated with blood, and all body fluids in situations where it is difficult or impossible to differentiate among body fluids (CDC, 1988; OSHA, 1991). Protective barriers such as gloves, masks, protective eyewear, and gowns reduce the risk of exposure of the health-care worker s skin or mucous membranes to potentially infective materials.

Blood.

Human blood, human blood components, and products made from human blood.

Contaminated.

The presence or reasonably anticipated presence of blood or other potentially infectious materials on an item or surface.

Visible blood.

Blood that is seen with the unaided eye (Phillips & Monaghan, 1997).

Occult blood.

Blood recognized by microscopic examination or by chemical means only (Phillips & Monaghan, 1997).

Laryngoscopy.

Instrumentation of the trachea with a vinyl tube that is accomplished through the nasopharynx or the oropharynx. The usual intubation technique is done by laryngoscopy and possibly aided by Magill forceps. Tracheal intubation is highly recommended by Chipas (1997, p. 715) in the following situations:

- Compromise or inaccessibility of the patient s airway.
- Long surgical procedure, during which fatigue could interfere with the maintenance of a patent airway with a mask.
- Surgical procedure on the head or neck.
- Need for controlled positive-pressure ventilation.
- Inability to maintain a patent airway with a mask or airway.
- Disease process involving the airway.
- Risk of aspiration from a full stomach.

Laryngoscope.

A rigid, inflexible medical instrument that consists of a battery-containing handle to which blades with a light source may be attached and removed interchangeably. Used to visualize the larynx, vocal cords, and surrounding structures during orotracheal intubation Chipas, 1997).

Laryngoscope Handle.

Vary in length and widths. Consists of a rough, etched surface that allows for a secure grip and contains batteries that supplies energy to a light source located in the blade (Stoelting & Miller, 1994).

Laryngoscope Blade.

Portion of the laryngoscope that is inserted into the patient s mouth. Blades vary in size and can be curved (Macintosh) or straight (Miller, Jackson-Wisconsin). Each blade contains a small light bulb located at the distal end (Stoelting & Miller, 1994).

Magill Forceps.

A stainless steel medical instrument that is often used when performing nasal intubation because the distal end of the

endotracheal tube must often be manipulated. This type of forcep is designed to be inserted through the oropharynx in order to grab the end of the endotracheal tube as it passes through the nasopharynx, gently guiding the tube to the desired location (Chipas, 1997).

Assumptions

First Assumption

All anesthesia intubation equipment identified as ready for patient use has undergone a high-level disinfection or sterilization process.

Second Assumption

The revised Spaulding classification system will continue to be used as a framework for identifying appropriate levels of disinfection and sterilization procedures for all medical instruments, equipment, and environmental surfaces in-patient care areas.

Third Assumption

The sensitivity of the phenolphthalein test (1:10,000 parts blood to normal saline) will not vary.

Fourth Assumption

The anesthesia intubation equipment consisting of laryngoscope blades, handles, and Magill forceps sampled at a large Military Medical Center, located in Bethesda, MD, is universally representative of standard anesthesia intubation equipment.

Limitations of Study

Burns and Grove (1993) state that limitations of a study are restrictions in a study that may decrease the generalizability of the findings (p. 46). Limitations of this study include generalizing the results to other medical treatment facilities and possible presence of the Hawthorne effect .

This study tested for visible or occult blood on anesthesia

intubation equipment located in areas outside of the operating room, from a large military medical treatment facility. A larger study that includes multiple facilities of different sizes over longer periods would expand generalization of results.

Knowledge of the study by staff members could influence how they carry out the standard operating procedures for disinfection and sterilization of anesthesia intubation equipment. The Hawthorne effect, described by Burns and Grove (1993), creates a threat to validity of findings. The investigator s strategy was to protect against this. This study was only discussed with the Research Administration Department of the Uniformed Services University of the Health Sciences; the Clinical Investigations Department; Head, Infection Control Department; Head, Crash Cart Committee; and Department Heads of the units being tested at the National Naval Medical Center, Bethesda, MD.

Summary

Anesthesia providers must ensure that they maintain a clean work environment in order to reduce the risk of bloodborne transmission to their patients and to themselves. They must be knowledgeable of the standards and exercise the recommended precautions set forth by OSHA, EPA, and the CDC. Florence Nightingale s grand theory placed great emphasis on the environment, and how the need for cleanliness extended not only to the patient, but also to the nurse and the surrounding environment. Previous studies have investigated the occurrence of visible and occult blood on anesthesia intubation equipment within the controlled environment of the operating room, yet no known studies have been conducted on this equipment located outside of the operating room; areas in which anesthesia personnel respond routinely for procedures and emergencies. This study determined the incidence of visible and occult blood on anesthesia intubation equipment identified as ready for patient

use located in emergency crash carts, airway management carts, and airway management bags used outside the operating room. The need to verify this was summarized by Phillips and Monaghan (1997) when they stated, The presence of blood is an indicator of potential cross-infection since blood is known to transmit several bloodborne infectious diseases (p. 6). With steadfast vigilance, nurse anesthetists can provide the safest possible environment for those undergoing surgical care, ultimately fostering the patient s healing process.

CHAPTER II: REVIEW OF THE LITERATURE

Introduction

Infection control is paramount to the prevention of nosocomial infections and the problems associated with them. Breedy (1988) reported that as many as 1.5 to 2.5 million people per year contract hospital-acquired infections, and approximately 15,000 patients are thought to die annually from nosocomial infections (p. 89). These occurrences are even greater in tertiary and university hospitals. Petersdorf (1980) states that microbes cause the majority of human diseases in which the etiology is known. He claims that stress, trauma, underlying disease states, and anesthetic agents may depress the normal immune system making patients more susceptible to infection. Some nosocomial infections may be no more troublesome than a minor inconvenience, while others can be life threatening, such as acquiring HBV, HCV, HIV, or other blood borne pathogens. The purpose of this review is to identify relevant historical and modern research conducted concerning infection control practices in regards to equipment used in airway management in the hospital environment. It is the expectation that this review will provide insight to the problem of visible and/or occult blood on airway management equipment. Furthermore, it lays the groundwork for the investigation of actual presence of blood on such equipment used outside of the operating room.

Review of the Literature

In Nursing Theories and Their Work (1993), deGraff, Marriner-Tomey, Mossman, and Slebodnik presented an historical overview of the matriarch of modern nursing, Florence Nightingale. They illustrate that throughout her career, controlling the environmental conditions that surrounded her patients was paramount. She focused her efforts toward reforming the sanitary conditions within the British army hospitals, among the lower

classes of England, and among the citizens of India. Florence Nightingale was a devoted statistician who collected information regarding the environmental practices that she implemented throughout her hospital nursing system. These data proved to be extremely efficacious during the Crimean War. In a report presented to the British Royal Sanitary Commission entitled Notes on Matters Affecting the Health, Efficiency, and Hospital Administration of the British Army, Nightingale charged for every man killed in battle in the Crimea, seven died from disease (pp. 74-75). She believed that the nurse s role was to prevent the healing process from being interrupted, and enhancing this process by providing optimal environmental conditions.

In the mid-twentieth century, optimal environmental conditions were promoted in the hospital setting by Dr. E.H. Spaulding (1968). He devised a rational disinfection and sterilization classification system for all patient care items and equipment. He believed that disinfection could be mastered more readily if instruments and items for patient care were separated into three categories; critical items, semicritical items, and non-critical items. These categories were based upon the risk of infection involved in the use of such items. His classification scheme was so clear and logical that it has been preserved, refined, and sanctioned for used by APIC, CDC, and OSHA.

Following the advent of Spaulding s (1968) classification system, Roberts (1973) looked at the presence of bacteria on laryngoscope blades following common cleaning practices of the day. He determined that washing the blades with warm water was the least effective method. The use of a 70% isopropyl alcohol solution was the best cold method, but was shown ineffective at inhibiting bacteria growth. Autoclaving was found extremely effective, rendering total sterility. Roberts recommended sterilization for all laryngoscope blades following completion of each

use.

Although Roberts (1973) advocated sterilization of laryngoscope blades following their use, this may not always occur even today. In a letter to the editor of the Journal of Hospital Infections, Foweraker (1995) noted that four pediatric patients had developed serious Pseudomonas aeruginosa infections, in which one of the children died from nosocomial pneumonia and septicemia. After thorough investigation of the environment, it was concluded that the probable source of infection came from a single laryngoscope blade that was used on each child. The blade had dried secretions around the bulb and on the blade, and when cultured, a moderate amount of P. aeruginosa of the same phage type isolated from the blood culture of the child who had died was found. Foweraker concluded that a breach in the cleaning and disinfection protocol had occurred. As a result, spot culture checks were instituted to ensure that cleaning policies were being properly carried out.

In the mid 1980s, identification of HIV in blood and body fluids motivated researchers to look at the potential risk that bloodborne pathogens presented to health care providers. Handsfield, Cummings, and Swenson (1987) found that health care personnel who handled clinical specimens were at increased risk for HBV and HIV infections. They analyzed the prevalence of hepatitis B surface antigen (HbsAg) and antibody to HIV in blood specimens submitted to a suburban hospital laboratory. This laboratory conducted tests on over 1000 collected specimens every four days. Serum or plasma specimens scheduled to be discarded, were collected on five separate days within a 14 day period. Findings indicated that 11 blood specimens were found positive for HIV, 49 specimens were positive for HBV, and 57 specimens contained both agents. Based on their findings, Handsfield and his colleagues recommended that all health care personnel follow the CDC s

recommendation for vaccination against HBV and to handle all clinical specimens as if they were infectious, utilizing gloves as protective devices.

Bready (1988) reviewed the role that anesthesia has upon the immune response, pointing out that various anesthetic agents impair cell-mediated resistance to infection. Laboratory experiments have shown that these agents cause diminished phagocytosis and inhibition of leukocyte oxidative processes. The activity of methionine synthase, an essential component in DNA synthesis, is also inhibited by the reaction of nitrous oxide and vitamin B12. This may lead to bone marrow suppression, megablastosis, and neutropenia in persons who are not in a healthy state prior to receiving nitrous oxide. Because of this, the risk of acquiring a nosocomial infection escalates in critically ill patients and those requiring invasive surgical, monitoring, and diagnostic techniques. Surgical procedures, invasive procedures, and endotracheal intubation breach the patient s mucosal and/or epithelial barriers, making an easy entry site for bacterial contamination.

As a patient advocate, the anesthetist has a responsibility to protect the patient from environmental risks that can occur in surgical patients and in those patients in which emergency airway management services are provided. Tait and Tuttle (1994) found this responsibility to fully protect the patient from environmental risk lacking among anesthesiologists. They surveyed practicing anesthesiologists, investigating whether or not common infection control practices were being implemented in their practices. The response of 495 anesthesiologists surveyed indicated that only 24% adhered to mandated CDC guidelines for the prevention of HIV, HBV, and HCV transmission (i.e., universal precautions) when patients were considered low risk. Eighty-eight percent always complied with the guidelines when presented

with an HIV-infected patient. The results of this investigation suggest that although most anesthesiologists use appropriate precautions for the prevention of occupational transmission of HIV and HBV, the concept of universal precautions was not fully embraced.

Kanefield, Munro, and Eisele (1989) were the first to investigate whether visible and/or occult blood was present on airway management equipment used in routine anesthetic practice. Their study investigated 100 elective general anesthetic with endotracheal intubation cases. Following each case, the equipment used to maintain the airway was inspected for the presence of visible gross blood and was then submerged into tap water for five minutes. The water was then tested for occult blood using a chemstrip. Kanefield and colleagues found that out of the 100 cases, 86 cases had airway management equipment that was positive for bloody secretions. Of these, 58% were contaminated with visible gross blood and 42% were identified as contaminated with occult blood; blood not visible to the naked eye. This was the first study that identified the presence of blood on airway management equipment following endotracheal intubations. The findings clearly illustrated the risk of blood exposure posed to anesthesia personnel with each intubation supporting the use of gloves as protection from bloodborne pathogens.

Chrisco and DeVane (1992) demonstrated that breaches in the mucosa following orotracheal intubation and extubation resulted in the presence of visible and occult blood. They sampled 163 patients who underwent oral endotracheal intubations and found that blood was present after 34% of the intubations. Of these, 70% had blood in the oral/pharyngeal cavity, and 52% revealed blood on the laryngoscope blade. Upon extubation, blood was found in 72% of the patients sampled. Of these, 50% were positive for visible blood and 50% were positive for occult blood. Blood was also present on the distal tip of the endotracheal

tubes in 97% of the cases.

Morell, Ririe, James, Crews, and Huffstetler (1994) sampled 38 laryngoscope blades and handles, from two hospitals, that were considered ready for patient use. After ensuring all cleaning solutions did not produce false-positive results, they tested the blades and handles for occult blood contamination using a guiac-based assay that detected the presence of blood in concentrations as low as 1:10,000. They found that 10% of the blades and 50% of the handles were contaminated with occult blood. Although neither institution had a protocol for handle cleaning, the anesthesia technicians admitted that they did wipe off the handles if the appeared grossly contaminated. As a result of their study, rigorous decontamination protocols and the use of disposable blades and handle covers were recommended. This study clearly indicated that reevaluation of cleaning and disinfection protocols for airway management equipment is necessary.

These studies offer scientific support that validates the universal precaution guidelines set forth by the CDC (1988) and OSHA (1991) which includes wearing gloves, masks, and protective eyewear during routine intubations and extubations. The frequent presence of blood noted on mucus membranes and airway management equipment reinforces the fact that all anesthesia providers are at risk for acquiring or transmitting blood-borne pathogens such as HIV, HBV, and HCV. Crow (1993, p. 688) stated that Universal precautions is the concept of treating all patients and their equipment as potential sources of infection because one cannot readily determine if a patient is infected or not.

Based on the findings of Morell et al. (1994), Tobin, Stevenson, and Hall (1995) developed and implemented a simple laryngoscope handle protection technique that diminishes potential bloodborne cross-contamination. They instituted the use of small, inexpensive, disposable

plastic bags that are placed over the handle and secured with tape. At the conclusion of each anesthetic case, the bag is removed and discarded, and a fresh bag is secured in its place. This procedure appears to be an ideal way to reduce cross-contamination from one patient to another. However, the authors did not explain that this must be done while employing a clean technique. Once the old bag is removed, hands must be thoroughly washed and/or re-gloved prior to placing a new bag onto the handle.

Shortly after Tobin, Stevenson, and Hall (1995) published their clean laryngoscope handle technique, Pogo, Inc. in Rochester, Minnesota, designed and manufactured disposable laryngoscope vacuum sleeves called The Pogo. These sleeves are made of clear polyethylene material. A one-way vacuum valve allows the material to completely conform tightly around the laryngoscope blade and handle. This product has the potential to dramatically reduce the potential for cross contamination of bloodborne pathogens between patients and staff. However, anesthesia providers have shown some resistance in using this new product, therefore, widespread utilization of this significant infection control device has not occurred.

The routine use of sterile gloves and exercising sterile techniques when performing invasive procedures provide the most significant protection for the patient from iatrogenic infections. The American Association of Nurse Anesthetist s Infection Control Guide (1993) also recommends that gloves should be worn when intubating the trachea, or when encountering the patient s secretions, excretions, and blood. Attention to aseptic technique is essential and must be incorporated into the work routine. Gadalla and Fong (1990) observed that anesthesia providers Carefully put on their gloves before induction only to place the dirty laryngoscope on the clean surface that is used for all the

syringes, tubes, airways, and other equipment to be used for both the current and subsequent cases (p. 1295). In addition to this, many providers proceed to touch the anesthesia machine, the monitoring equipment, and the patient s chart using the same gloves that they used to intubate the patient. Gadella and Fong advocate wearing two pairs of gloves at the beginning of the case. After the induction is carried out, the blade of the laryngoscope should be covered by the glove, which is pealed off the hand and inverted over the dirty laryngoscope blade. The other outer glove is then removed, allowing the anesthetist to have a clean pair of gloves to pursue other tasks during the case.

The results of the study performed by Morell et al. (1994) prompted Hall (1994) to take his study a step further. He investigated the extent of blood contamination on anesthesia and monitoring equipment located in operating rooms. Of the nineteen surfaces sampled in 22 operating rooms identified as ready for patient use for surgery and anesthesia, 33% were found to be contaminated with blood. In this study, blood in stain form, rather than solution was tested. The three-stage phenolphthalein blood indicator test (alcohol-phenolphthalein-hydrogen peroxide) provided the necessary specificity, eliminating false-positive results that could result from iodine-containing compounds. Hall recommended that this test should be used whenever improvements in clinical practice are being directed toward cleaning and disinfection of blood-contaminated equipment (p. 1138).

Hall s study (1994) did not determine if blood contamination represents an infection risk to the patient or anesthesia provider. However, Favero, Bond, and Peterson (1974) found the hepatitis B virus to be viable on metal surfaces for up to two weeks, and demonstrated the antigenic stability of this virus to exist for seven years (Bond, Favero, & Peterson, 1981).

Phillips and Monaghan (1997) investigated the incidence of visible and occult blood on laryngoscope blades and handles that were identified as ready for patient use in the operating room setting, using the same modified three-stage phenolphthalein blood indicator test that Hall (1994) used. A total of 65 blades and handles were tested. Thirty-five blades and handles were tested prior to the beginning of the day s cases and 30 blades and handles were tested at the end of the day. The results concluded that none of the blades or handles were observed to have visible blood, yet 20% of the blades and 40% of the handles tested positive for occult blood. Afternoon samples identified the greatest amount of occult blood, which suggests that the handles, which are frequently returned to the top of the cart and then reused on the next patient, were a potential source of cross-contamination.

Perhaps the most compelling reason for re-evaluating the cleaning, disinfection, and sterilization techniques of airway management equipment comes from the recent report of outbreaks of Mycobacterium tuberculosis infections following bronchoscopic procedures. A retrospective study, which assessed nosocomial transmission of multidrug-resistant tuberculosis (MDR TB), was performed by Agerton et al. (1997) after eight patients with MDR TB were identified in a single community hospital in South Carolina in 1995. Community links were identified in five of the cases; however, no links were identified in the remaining three patients except that each patient had been hospitalized at different times in the same institution, and each had received a bronchoscopic procedure after one was performed on a patient with active MDR TB. The same bronchoscope was used in each case and DNA fingerprint patterns of all three patients matched the strain found in the initial patient who underwent bronchoscopy. The investigators concluded that inadequate cleaning and disinfection of the bronchoscope following each procedure led to cross-

infection in these patients. This is the first documented case in which nosocomial transmission of MDR TB was caused by a contaminated bronchoscope.

Michele et al. (1997) also identified cross-infection of Mycobacterium tuberculosis in two patients who underwent fiberoptic bronchoscopy. Using a traditional and molecular epidemiological investigation, they found that each patient had undergone bronchoscopy with the same instrument in the same operating room with no intervening bronchoscopes, and that cleaning and disinfection procedures were inconsistent with national guidelines. No opportunities for disease transmission between the two subjects occurred, and DNA fingerprinting revealed identical stains of M. tuberculosis.

Summary

Florence Nightingale s grand theory on nursing, Dr. Spaulding s (1968) classification system for processing patient care items and equipment, and the standards set forth by the CDC (1988) and OSHA (1991), attempt to control the environment surrounding the patient in order to provide an optimal setting that fosters the healing process. Numerous studies have shown that orotracheal intubations and extubations are bloody, indicating that breeches in the mucosal and epithelial membranes occur during this common procedure. Anesthesia equipment considered ready for patient use have shown considerable amounts of visible and/or occult blood contamination. This is inconsistent with today s infection control standards. Blood transmits deadly infectious diseases such as HIV, HBV, and HCV; therefore, if a piece of equipment is contaminated with visible and/or occult blood, the potential for cross-infection to patients and their providers is highly likely. This, along with recent evidence of transmission of MDR TB during bronchoscopy, illustrate the need for continued vigilance and evaluation of airway management

equipment cleaning techniques.

These data indicate that proper cleaning, sterilization, and decontamination of anesthesia equipment between surgical cases is vital in reducing transmission of nosocomial infections to patients and providers. Adherence to standards should be routinely assessed to guarantee a safe environment. A review of the literature indicates that studies have been performed predominantly in the perioperative setting. No study measuring the effectiveness of cleaning, disinfection, and sterilization of anesthesia airway management equipment used outside of the operating room has been performed. A study that surveyed anesthesia airway management equipment used outside the operating room was conducted in order to document and compare the frequency of blood contamination on such equipment.

CHAPTER III: METHODS

Introduction

Controlling and preventing the transmission of bloodborne pathogens is paramount in today s health care environment. Previous studies have shown that equipment considered ready for patient use have considerable amounts of visible and/or occult blood contamination. This is incongruent with today s infection control standards. Chapter I and II of this proposal have laid the groundwork for this study. This chapter describes the methods that were used in determining the prevalence of visible and/or occult blood on airway management equipment used outside the operating room.

Research Design and Procedures

Leedy (1997) states that we can gain an understanding of transient phenomenon by observing events that take place around us through non-experimental quantitative research. He points out that a descriptive survey is a method of research that looks with intense accuracy at the phenomena of the moment and then describes precisely what the researcher sees (p. 190). This study assembled data for a descriptive analysis regarding the prevalence of visible and/or occult blood on airway management equipment used outside the operating room in one large military medical facility.

Following submission and approval of this proposal by the Research Administration Department (REA) of the Uniformed Services University of the Health Sciences (USUHS) and the Clinical Investigations Department, National Naval Medical Center (NNMC), located in Bethesda, Maryland, data were collected at the NNMC in March of 1999.

Airway management equipment (laryngoscope blades, laryngoscope handles, and Magill forceps) considered ready for patient use located in emergency crash carts, airway management carts, and airway management

bags of the Emergency Room, Post Anesthesia Care Unit, Anesthesia Department, Combined Medical/Surgical Intensive Care Unit, Combined Cardiac Care/Cardio-Thoracic Intensive Care Unit, Neonatal Intensive Care Unit, and the Labor and Delivery Suite, were tested in this study.

Visible inspection and occult blood testing were conducted on the equipment. The surface of every laryngoscope blade, laryngoscope handle, and Magill forcep within an emergency crash cart, airway management cart and/or bag was carefully inspected for the presence of visible blood. Following inspection, each piece of equipment was swabbed with individual 70% isopropyl alcohol pads. Each alcohol pad was placed into a zip-lock storage bag and properly labeled according to the equipment that was swabbed, along with date, time, and location from where the specimen was obtained. Clean technique was employed with each specimen collected: clean latex gloves were donned before picking up each individual piece of equipment, and were discarded after swabbing took place and specimen was secured into a zip-locked bag. This procedure was followed with every piece of equipment to ensure that cross-contamination between instruments did not occur. Following collection from an individual unit, the specimens were tested for occult blood using a modified phenolphthalein blood indicator test. Strict adherence to clean technique was followed with each specimen.

Phillips and Monaghan (1997) carried out reliability and validity testing of the three-stage Phenolphthalein Test Kit (Cluefinders, Inc., Tampa, Fl.) and found the test to be extremely sensitive, with the ability to identify 1:10,000 parts blood to normal saline within sixty seconds. Because of the demonstrated sensitivity of the phenolphthalein test, this method was employed throughout the study to detect the presence of occult blood on airway management equipment. Prior to conducting the test, all samples were placed against a white background

to aid in the identification of positive and negative results. The proposed timeline for plan of action and milestones (POAM) of this study is shown in Table 1.

Table 1:

Thesis Research Plan of Action and Milestone Tasks for Data Collection, Data Analysis, and Thesis Defense.

Plan of Action and Milestone Tasks	APR 98	MAY 98	JUN 98	JUL 98	AUG 98	SEP 98	OCT 98	NOV 98	DEC 98	JAN 99	FEB 99
1. Contact Crash Cart Committee Chair at NNMC	X										
2. Complete Thesis Proposal	X										
3. Arrange for Proposal Defense	X										
4. Propose Defense		X									
5. Submit copy of thesis proposal to GSN: USUHS		X									
6. Submit copy of thesis proposal to REA: USUHS		X									
7. Submit copy of thesis proposal to Clinical Investigations Department: NNMC		X									
8. Submit proposal to Dean of GSN for final approval		X									
9. Begin Data Collection			X								
10. Complete Data Collection					X						
11. Analyze Data						X					
12. Write up results, conclusions, & recommendations								X			
13. Draft of completed thesis to committee members									X		
14. Arrange for thesis defense									X		
15. Thesis Defense										X	
16. Make revisions to thesis as needed											X
17. Obtain signatures of committee members											X
18. Submit completed original thesis and 3 copies to the Office of the Dean, GSN											X

Purpose of Data Collection: To determine the prevalence of visible and/or occult blood on airway management equipment located outside of the perioperative setting.

Location of Research Study: National Naval Medical Center Bethesda, Maryland

I. Demographic Data:

A. Date of specimen collection: ____/____/____
Day Month Year

B. Day of the week: S M T W Th F S

C. Actual time of specimen collection: ____/____
Military) Hour Min

D. Crash Cart Seal Intact? Yes No

II. Specific Hospital Unit of Data Collection:

A - Emergency Room
B - Post Anesthesia Care Unit
C - Anesthesia Department
D - Combined Medical/Surgical Intensive Care Unit
E - Combined Cardiac Care/Cardio-Thoracic Intensive Care Unit
F - Neonatal Intensive Care Unit
G - Labor and Delivery Suite

III. Airway Management Equipment (AME):

A. Laryngoscope Blades

B. Laryngoscope Handles

C. Magill Forceps

Figure 1.

Visible and Occult Blood Data Collection Framework for Airway Management Equipment Located in Emergency Crash Carts, Airway Management Carts, and Airway Management Bags.

Sample

A convenience sample was taken from all laryngoscope blades, laryngoscope handles, and Magill forceps located in emergency crash carts, airway management carts, and airway management bags from the previously identified locations (see Figure 1, Data Collection Framework). Based on the findings of Phillips and Monaghan (1997), occult blood contamination was expected to be between 30-35%. Using the method of Kraemer and Thiemann (1987), at a .05 significance level (two-tailed) and a large effect size, it was determined that the size of the sample needed to attain a power of .80 was at least 10.

Measurement

Results of visible and/or occult blood were recorded as yes or no on a data collection tool (see Appendix A). Careful visual inspection of each piece of equipment was done and results recorded by the researcher. Each piece of equipment was then swabbed with individual 70% isopropyl alcohol pads. Each pad was placed into a zip-locked bag. Once all samples were collected from the identified unit, the phenolphthalein blood indicator test was performed on the specimens. This process continued until all units were tested.

The phenolphthalein blood indicator test is based on chemistry principles, utilizing the process of oxidation and reduction reactions. In the presence of hemoglobin, the phenolphthalein reagent is rapidly oxidized, possessing catalytic peroxidase-like activity. The addition of hydrogen peroxide causes oxygen to be transferred from the hydrogen peroxide to the phenolphthalein reagent. The pink color change is the result of oxidization of phenolphthalein reagent, indicating that blood is present on specimen. This test will only turn positive if hemoglobin is present, therefore its specificity for blood is 100%.

Due to the inability to obtain the three-stage Phenolphthalein Test

Kit from Cluefinders, Inc., Tampa, Fl., a similar test kit, Phenolphthalein Dischaps_ Blood Test Reagent (Sirchie¤Finger Print Laboratories, Inc, Youngsville, NC.) was obtained. Prior to collecting data, the sensitivity and reliability of this test was determined on two separate occasions, by the researcher, to ensure accurate results. A serial dilution of blood (1:10 up to 1:10,000,000,000) was made using a drop of the researcher s own blood and .9% Normal Saline. A tube containing only .9% NS was used as a control. This commercially prepared phenolphthalein test was found to be sensitive to 1:10,000, in two separate serial dilution tests, on filter paper moistened with distilled water and on 70% isopropyl alcohol pads within 60 seconds (modified method). It was noted that a positive result occurred much faster on the alcohol pads than on the filter paper, but no change in the sensitivity and reliability was found between the two methods. After two minutes, the reagent caused a faint halo of pink color on both the filter paper and the alcohol pads. Because of this, all samples tested were read for color change within 60 seconds of placing the reagent. Any specimen that developed a halo of pink color after two minutes was disregarded. All samples were placed on a white background, prior to placing the reagent, to aid in the identification of positive and negative results. Results of each test were recorded on the data collection form (see Appendix A).

Protection of Human Rights

Approval from the Research Administration Department at the Uniformed Service University of the Health Sciences and the Clinical Investigations Department at the National Naval Medical Center, Bethesda, MD., was obtained prior to collecting data. This study contained no human or animal subjects; therefore, informed consent was not required.

Data Analysis

All results were recorded on the data collection form. A data dictionary was designed to ease data entry for statistical analysis (see Appendix B). The collected data were analyzed using the Statistical Package for the Social Sciences (SPSS). Determining effectiveness of current cleaning, disinfection, and sterilization procedures are on ready for patient use AME located in emergency crash carts, airway management carts, and airway management bags was done using frequency and crosstabulation.

To ascertain the difference in occurrence of visible and/or occult blood on AME located in emergency crash carts, airway management carts, and airway management bags, compared to equipment used in operating rooms, a historical comparison was conducted. Study data were compared to data reported in the literature to determine differences in occurrence of blood.

Summary

This descriptive study evaluated airway management equipment used outside the operating room in order to document the prevalence of blood contamination on such equipment. This study was conducted in a large military medical center. Strict adherence to clean technique was employed throughout the data collection process. Statistical techniques were employed to determine the frequency of occurrence.

CHAPTER IV: PRESENTATION, ANALYSIS & INTERPRETATION OF DATA

Introduction

Leedy (1997) states the purpose of research is to seek the answer to a problem in the light of the data that relate to that problem (p. 220). Thus, the key to solving the problem occurs only after the data have been accumulated and accurate interpretation takes place. This chapter answers the research questions posed at the onset of this study.

Restatement of the Questions

The research questions were as follows:

1. How effective are current procedures for cleaning, disinfection, sterilization, and handling of AME located in emergency crash carts, airway management carts, and airway management bags located outside the operating room, for removing blood as evidenced by the lack of visible and/or occult blood on laryngoscope blades, handles, and Magill forceps identified as ready for patient use ?
2. Is there a difference in occurrence of visible or occult blood on AME located in emergency crash carts, airway management carts, and airway management bags, compared to equipment used in operating rooms?

Results

A total of 211 pieces of AME located in emergency crash carts, airway management carts, and airway management bags of the Emergency Room, Post Anesthesia Care Unit, Anesthesia Department, Combined Medical/Surgical Intensive Care Unit, Combined Cardiac Care/Cardio-Thoracic Intensive Care Unit, Neonatal Intensive Care Unit, and the Labor and Delivery Suite were sampled. Visible inspection revealed 16 of 211 specimens (7.6%) that appeared to be positive for visible blood, whereas only 8 (3%) actually tested positive for occult blood when the

phenolphthalein blood indicator test reagent was applied. Thirty-six samples (17%) tested positive for occult blood within sixty seconds of applying the reagent (see Table 2 and Figure 2).

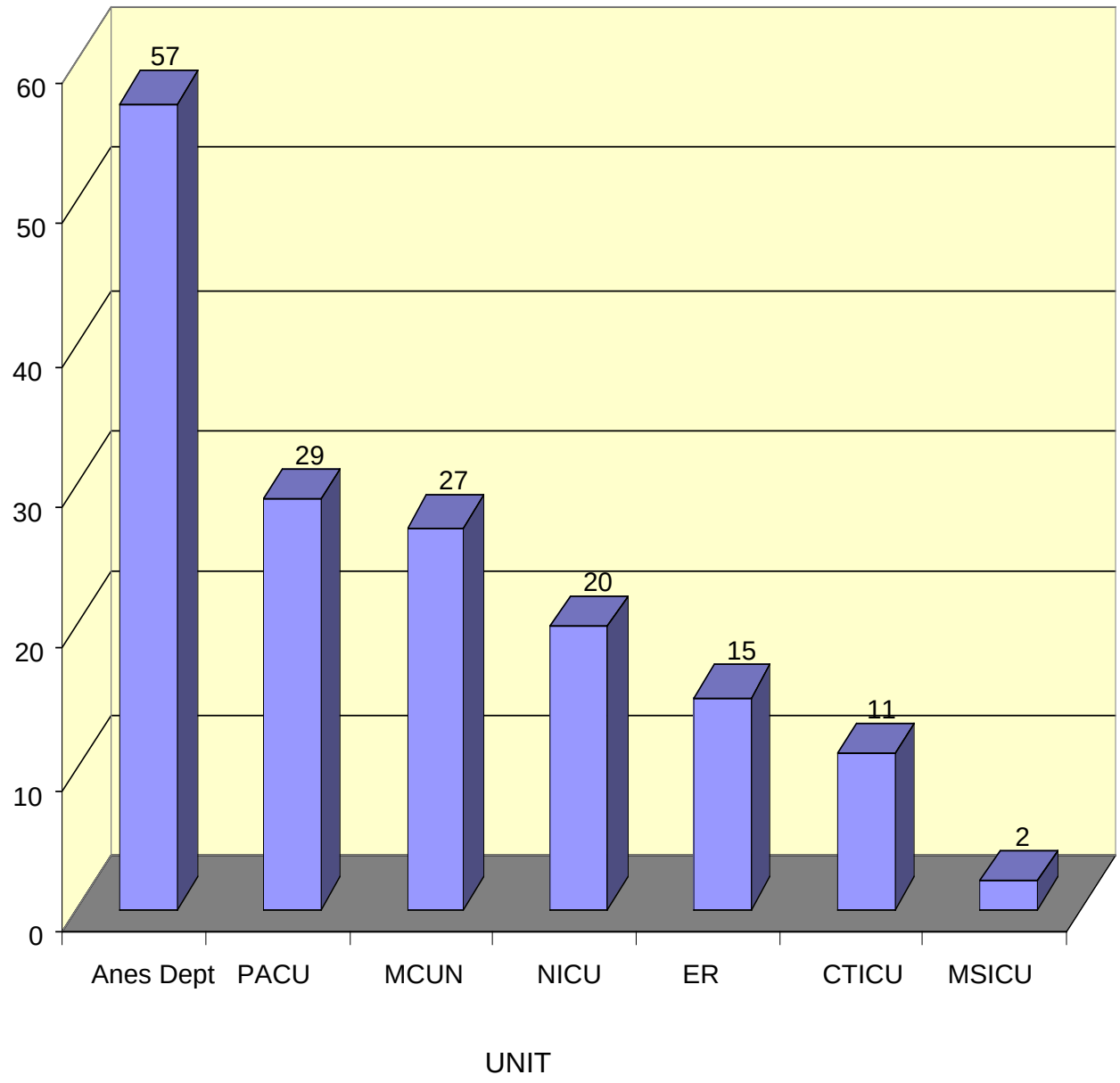
Table 2.

Prevalence of Occult Blood on Airway Management Equipment

Occult Blood	Frequency	Percent
Yes	36	17.1
No	175	82.9
Total	211	100.0

Figure 2

Prevalence of Occult Blood on Airway Management Equipment by Unit



Source: Table 4.

One hundred and forty-eight laryngoscope blades were tested. Of those, 28 (18.9%) tested positive. Of the 43 laryngoscope handles tested, 8 (18.6%) were positive for occult blood. No occult blood was found on any Magill forceps (see Table 3).

Table 3.

Prevalence of Occult Blood on Specific Airway Management Equipment

Airway Management Equipment	Occult Blood		Total	Blood Present (%)
	Yes	No		
Laryngoscope Blade	28	120	148	19
Laryngoscope Handle	8	35	43	19
Magill Forceps	0	20	20	0
Total	36	175	211	17

Of the seven units tested, the Anesthesia Department had the highest incidence of occult blood. Of 14 specimens sampled, 8 (57%) tested positive for occult blood within 60 seconds. Twenty-eight specimens were sampled from the Post Anesthesia Care Unit. Of those, eight (29%) tested positive. Twenty-two specimens were sampled from the Maternal Infant Child Unit, six (27%) tested positive. Twenty-five samples were taken from the Neonatal Intensive Care Unit and five (20%) were positive for occult blood. Of 26 samples taken from the Emergency Room, four (15%) tested positive, and of the 36 samples taken from the Cardio-Thoracic Intensive Care Unit, four (11%) tested positive for occult blood. The

Medical/Surgical Intensive Care Unit had the lowest overall incidence of occult blood. Sixty specimens were sampled and only one (2%) tested positive (see Table 4).

Table 4.

Prevalence of Occult Blood on Airway Management Equipment by Unit

Unit Tested	Occult Blood		Total	Blood Present (%)
	Yes	No		
Emergency Room	4	22	26	15
Post Anesthesia Care Unit	8	20	28	29
Anesthesia Department	8	6	14	57
Med/Surg Intensive Care Unit	1	59	60	2
Cardio-Thoracic Intensive Care Unit	4	32	36	11
Neonatal Intensive Care Unit	5	20	25	20
Maternal Infant Child Unit	6	16	22	27
Total	36	175	211	17

Of the units tested, the following devices were found to hold airway management equipment: neonatal admission bedside carts, airway management bags, emergency crash carts, airway management carts, and neonatal/pediatric airway management bags. Of the 28 specimens sampled from the admission bedside carts located in the Neonatal Intensive Care Unit, nine (32%) tested positive for occult blood. Sixty-two specimens were sampled from airway management bags, of those, 15 (24%) tested

positive for occult blood. Ninety-five samples were taken from emergency crash carts, 11 (12%) tested positive. Nineteen specimens were sampled from airway management carts, with only one (6%) testing positive. No occult blood was found on AME located in the neonatal/pediatric airway management bags (see Table 5).

Table 5.

Prevalence of Occult Blood on Airway Management Equipment by Type of Cart

Type of Cart	Occult Blood		Total	Blood Present (%)
	Yes	No		
Emergency Crash Cart	11	84	95	12
Airway Management Cart	1	18	19	6
Neonatal Bedside Cart	9	19	28	32
Airway Management Bag	15	47	62	24
Neonatal /Pediatric Airway Management Bag	0	7	7	0
Total	36	175	211	17

Summary

This study revealed that visible and/or occult blood was present on AME that is designated as ready for patient use located in emergency crash carts, airway management carts, and airway management bags. These findings are consistent with a similar studies done by Morell, Riries, James, Crew, and Huffstetler (1994), and Phillips and Monaghan (1997), which found occult blood on AME identified as ready for patient use in the operating room.

CHAPTER V: CONCLUSIONS, RECOMMENDATIONS

Overview of the study

The purpose of this study was to determine how effective current procedures for cleaning, disinfection, sterilization, and handling of AME located in emergency crash carts, airway management carts, and airway management bags, located outside the operating room, are in removing blood, and to compare these data with previous studies on this equipment as used within the operating room setting. This investigation took place at a large military medical facility that had clear, concise, written standard operating procedures (SOPs) on how to carry out high-level disinfection of patient care equipment, meeting standards set forth by OSHA and the EPA. These SOP s were found in the Infection Control Manual on every unit tested and clearly defined the following steps involved in the process of high-level disinfection: (1) scrupulous mechanical cleaning (using appropriate brushes) to be done prior to disinfection; (2) germicides registered with the Environmental Protection Agency (EPA) as sterilant/disinfectant agents are to be used to disinfect equipment, (3) minimum disinfectant contact time for high-level disinfection is at least 20 minutes; (4) adequate rinsing of equipment is to follow disinfection; and (5) equipment is to be air dried and stored in a way that prevents recontamination or damage between use.

Blood was used as an indicator to determine effectiveness of and compliance with established cleaning, disinfection, and sterilization protocols. The presence of blood on AME implies that a potential for unintentional transmission of blood-born pathogens to patients and providers exists.

Implication of the Results

This study used the Phenolphthalein Dischaps“ Blood Test Reagent

(Sirchie_ Finger Print Laboratories, Inc., Youngsville, NC.) to determine the presence or absence of blood. At this facility, 17% of the AME tested positive for blood contamination, with the incidence of occult blood on laryngoscope blades and handles being 19% respectively. No blood was found on any Magill forceps tested. Magill forceps are used to assist the anesthesia provider in placement of a nasal endotracheal tube. Although they are an essential part of AME located in emergency crash carts, airway management bags and airway management carts, nasal intubations are rarely indicated in most emergent airway management situations. Their being free from any blood could possibly be due to the fact that they are used so rarely, if at all. The results are conclusive that AME identified as ready for patient use outside the operating room are contaminated with blood, indicating that a deficiency in compliance with established cleaning, disinfection, and sterilization protocols exists.

Visible inspection of the AME was unreliable in determining the prevalence of blood on AME. Only 8 of the 36 specimens testing positive for occult blood were seen with the naked eye, with the remaining positive tests being undetectable. This finding demonstrates that equipment that appears to be clean may in fact be grossly contaminated with blood or other potentially infectious material.

At this facility it was found that the cleaning, disinfection, sterilization, and handling practices of used AME varied greatly according to where the AME was stored (i.e. emergency crash carts, airway management bags, and airway management carts), and from the unit being tested. According to this hospital s crash cart protocol, all AME used from emergency crash carts are sent to the Sterile Processing Department (SPD) for high-level disinfection. Because the SPD processes the

majority of sterile equipment used throughout the hospital, the researcher assumed that AME sampled from emergency crash carts would have the least amount of occult blood. This did not prove to be the case. AME located in these crash carts revealed a 12% occurrence of occult blood, indicating that there is a need for the SPD to reevaluate their procedures and practices involved in cleaning, disinfection, and sterilization. AME from airway management bags and carts are not sent to SPD for processing after use, rather, each unit is responsible for cleaning their own equipment according to the hospital s SOP. The Anesthesia Department is responsible for cleaning its own AME along with the equipment used in the Post Anesthesia Care Unit s (PACU). Their cleaning, disinfection, and sterilization process involved scrubbing the equipment only if there was visible blood/tissue, soaking the AME in a germicidal solution for the prescribed time, followed by adequate rinsing. An additional step of pasteurization was performed on their AME. Surprisingly, the AME sampled from the Anesthesia Department s airway management bag had a 57% incidence of occult blood and the PACU s airway management bag had a 28% incidence. The overall prevalence of occult blood on AME was highest from these two units (see Table 3). These findings are most likely due to inadequate or non-existent mechanical cleaning prior to submersion into the germicidal solution. Another possible cause could be in the design of the airway management bag itself. These bags are fitted with deep pockets that hold the laryngoscope blades, handles, and Magill forceps. It is possible that the pockets may have become grossly contaminated with blood at one time, and cross-contamination of clean equipment could have occurred. This type of scenario is unlikely, however, since no Magill forceps were found to have residual occult blood, though they were kept inside the pockets along with the blades and handles.

The Medical/Surgical Intensive Care Unit had the overall lowest incidence of occult blood , less than 2%. They stated that they rarely, if ever, used AME from the emergency crash carts located in their unit, but rather used their airway management bags in most emergent medical situations. If AME is used during an emergent situation, following the emergency it is cleaned and disinfected, following the hospital s SOP very closely. Their strict compliance and adherence SOP is evident in the very low prevalence of occult blood found on their AME.

The overall incidence of occult blood on AME in the Neonatal Intensive Care Unit was 20%, but increased to 32% on AME located in admission bedside carts. Again, this unit rarely, if ever, used AME from the emergency crash cart. They preferred using AME located in the admission bedside carts. Upon interviewing unit personnel, it was found that they did not follow the hospital s SOP for cleaning and disinfection of this equipment. Terminal cleaning involved rinsing the AME off under tap water followed by a quick spraying of germicidal solution. The equipment was then wiped off with a clean towelette before returning it to the admission bedside cart. The vital steps involved in high-level disinfection of patient care equipment (i.e. mechanical cleaning and minimal disinfectant contact time) was not carried out.

This study revealed that visible and/or occult blood was present on AME that was designated as ready for patient use located in emergency crash carts, airway management carts, and airway management bags. These findings are consistent with similar studies done by Morell, Ririe, James, Crews, and Huffstetler (1994), and Phillips and Monaghan (1997).

Using a guiac-based assay that detected the presence of blood in concentrations as low as 1:10,000, Morell et al. (1994) found that 11% of the blades and 50% of the handles located in the operating room, identified as ready for patient use , were contaminated with occult

blood. Because of this study, rigorous decontamination protocols and use of disposable blades and handle covers were recommended so that equipment to be used on patients is free from potentially infectious materials. Phillips and Monaghan (1997) also identified the presence of occult blood on ready for patient use AME located in the operating room using a modified phenolphthalein test with a sensitivity of 1:10,000. Thirty-percent of laryngoscope blades and 40% of laryngoscope handles tested positive for occult blood; however, no visible blood was found on any of the equipment. Poor compliance with established cleaning and disinfecting protocols was cited as the main reason for the presence of occult blood on laryngoscope blades and handles. It was concluded that cross-contamination from the used laryngoscope blade to the laryngoscope handle probably occurred since the used blade easily comes into contact with the laryngoscope handle if it is placed in the folded position.

This study found a 3% occurrence of visible blood that tested positive for occult blood on AME used outside the operating room. The overall prevalence of occult blood in this study was 17%, with the occurrence of occult blood on laryngoscope blades and handles being 19% respectfully. The lower incidence of occult blood on AME in this study are undoubtedly due to better cleaning, disinfection, sterilization, and handling procedures than equipment used in the operating room. High-level disinfection carried out by the SPD for all AME used from emergency crash carts (n=95) along with extreme vigilance in following established SOP s by units such as the Medical/Surgical ICU staff most likely explains the reduced overall prevalence of occult blood.

Recommendations

Unintentional transmission of blood-borne pathogens to patients, self, and co-workers is an inherent, but preventable hazard to those who provide anesthesia services. This study found AME used outside the

operating room by anesthesia personnel to be contaminated with visible and occult blood. The ramifications of this prevalence are profound when considering data that has clearly shown that cross-contamination of blood-borne pathogens are a constant, deadly threat to health care providers and their clients (Bready, 1988; Tait & Tuttle, 1994; Kent, 1996; CDC, 1997). The recommendations that follow are intended to reduce potential transmission.

Crow (1993) reminds health care providers that regardless of the sterilization process selected, an item must be cleaned thoroughly before the process can be effective. If an item cannot be cleaned, it cannot be sterilized or disinfected (p. 687). Poor compliance with established cleaning, disinfection, and sterilization protocols was found to be the primary cause for prevalence of visible and/or occult blood on AME tested in this study. Personnel responsible for processing used AME must be educated on the ramifications of improper cleaning, disinfection, and sterilization techniques, and instructed on correct steps involved in such a process.

Standardized processing of all AME used throughout the hospital by one department (i.e. SPD) may dramatically reduce the prevalence of blood on such equipment. Making one department solely responsible for processing the equipment may eliminate variability in compliance with hospital standards.

The phenolphthalein blood test reagent has a sensitivity of 1:10,000 and is 100% specific for blood. This inexpensive test could be implemented periodically by infection control departments as a spot check on AME to ensure standards set forth by OSHA and EPA regarding high-level disinfection are being met.

Finally, implementing the use of disposable AME in emergency crash carts, airway management bags, and airway management carts used outside

the operating room would eliminate cross-contamination of blood-borne pathogens. The high cost associated with disposable AME equipment, along with resistance to use by anesthesia personnel, has diminished widespread utilization of this significant infection control device.

Future Studies

Duplication of this study in large and small medical facilities would provide more information on the prevalence of visible and/or occult blood on AME used outside the operating room. Agerton et al. (1997) and Michele et al. (1997) recently reported on outbreaks of multidrug-resistant Mycobacterium tuberculosis following bronchoscopic procedures. Because of this, additional studies looking at the cleaning, disinfection, and sterilization techniques as evidenced by the presence or absence of visible and/or occult blood on fiberoptic equipment, used in the operating room to visualize and intubate the trachea, should be performed.

Summary

Florence Nightingale s grand theory of nursing placed great emphasis on environmental factors that affected the wellness of patients. Although she did not accept the current germ theory of her time, she developed and implemented the idea of asepsis as a means to control infection and to prevent the healing process from being interrupted, thus providing optimal environmental conditions for recovery. Dr. E.H. Spaulding, renowned for his work on chemical disinfection and asepsis in hospital settings, developed a classification system which identified appropriate levels of disinfection and sterilization procedures for all medical instruments, equipment, and environmental surfaces in patient care areas during the late 1960s (AANA, 1993; Rutala, 1996). Over the years, OSHA, CDC, and the APIC have embraced and revised his system as the framework for all health care facilities to follow in order to

prevent and control nosocomial infections.

Nightingale s theory and Spaulding s classification system was used as a conceptual model and theoretical framework for this study. This study verified the effectiveness of cleaning, disinfection, and sterilization of AME used outside the operating room, compared to equipment used in the operating room so as to identify processes that need improvement in order to prevent cross-contamination of blood-borne pathogens.

These data showed the presence of visible and occult blood on AME used outside the operating room. The effectiveness of current procedures for cleaning, disinfection, sterilization, and handling of AME located in emergency crash carts, airway management carts, and airway management bags were discussed. Prevalence of occult blood was analyzed according to the type of equipment, type of cart, and unit tested. The findings were consistent to similar studies performed in the past, and recommendations were given to decrease the prevalence of visible and/or occult blood on AME used outside the operating room. Future studies looking at decontamination protocols will continue to identify areas that need improvement in order to protect patients and providers from potentially deadly cross-contamination.

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APPENDICES

APPENDIX A: Data Collection Forms

Appendix A
Room #/or Location_____

Visible and Occult Blood Data Collection Tool For Airway Management Equipment Located in Emergency Crash Carts, Airway Management Carts, and Airway Management Bags

(Sample of Multi-use Tool)

I. Demographics:

A. Date of specimen collection: _____/_____/_____
Day Month Year

B. Day of the week: S M T W Th F S

C. Actual time of specimen collection: | | _____/_____
(Military) Hour Min

D. Crash Cart Seal Intact? Yes No

II. Specific Unit: _____(1-Emergency Room)_____

III. Type of AME: _____(2-Laryngoscope Handle)_____

Handle Number	Visible Blood		Occult Blood	
	YES	NO	YES	NO
Handle 1				
Handle 2				
Handle 3				
Handle 4				
Handle 5				
Handle 6				
Handle 7				
Handle 8				

APPENDIX B: Data Dictionary

Appendix B

Data Dictionary For Coded Variables

I.	Demographics	Number of Digits
	Date of specimen collection	(6)
	Day of the week	(1)
	Monday = 1	
	Tuesday = 2	
	Wednesday = 3	
	Thursday = 4	
	Friday = 5	
	Saturday = 6	
	Sunday = 7	
	Actual time of specimen collection	(4)
	Crash Cart Seal Intact	(1)
	Yes = 1	
	No = 2	
II.	Specific Hospital Unit of Data Collection	(1)
	Emergency Room = 1	
	Post Anesthesia Care Unit = 2	
	Anesthesia Department = 3	
	Combined Medical/Surgical Intensive Care Unit = 4	
	Combined Cardiac Care/ Cardio-Thoracic Intensive Care Unit = 5	
	Neonatal Intensive Care Unit = 6	
	Labor and Delivery Suite = 7	
III.	Type of airway management equipment	(1)
	Laryngoscope Blade = 1	
	Laryngoscope Handle = 2	
	Magill Forceps = 3	
IV.	Presence of visible blood	(1)
	Yes = 1	
	No = 2	
V.	Presence of occult blood	(1)
	Yes = 1	
	No = 2	

VI. Example of coded variable